

426/29
23 44
51
A.D. 1886, 13th APRIL. N° 5152.

COMPLETE SPECIFICATION.

Improvements in the Manufacture of Ale, Beer, and Porter.

We, NARCISSE PIGEON and WILLIAM LIVINGSTONE FLANAGAN of No. 450 West 26th. Street, in the City, County and State of New York, United States of America, Manufacturers, do hereby declare the nature of our invention for "IMPROVEMENTS IN THE MANUFACTURE OF ALE, BEER AND PORTER," and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

By the methods heretofore generally employed in the manufacture of ale, beer and porter, the barley is first converted into malt from which, by mashing the same with water, an extract of malt is formed which constitutes the well-known malt "wort" of the breweries. The malting operation is always attended with a considerable loss of the valuable properties of the grain, and this together with the time, fuel and labor consumed in converting the grain into malt constitutes a large item of expense in the manufacture of malt liquors.

The object of our invention is to obtain from barley, during the brewing process, a wort equivalent to malt wort without subjecting a considerable proportion of the barley to the usual malting operation: also, to extract from grain in the manufacture of malt liquors the maximum of valuable material for this purpose, during the brewing process, which will amount to about five per centum over that obtained by the ordinary mash-tun process.

Our invention relates especially to that step in the manufacture of malt liquors known as the mashing operation, in which the malt is mixed with water and heated at the proper temperature during the proper time to form the wort.

In carrying out our invention we prefer to use a water-bath converter which consists, in the main, of an interior vessel or chamber surrounded by a water jacket and provided with proper agitators, the construction and operation being such that the temperature of the liquid contents of the interior vessel can be varied by increasing or decreasing the temperature of the water in the jacket by injecting steam or by steam coils placed therein. In connection with the converter, straining tubs of usual construction, except that they are preferably furnished with false bottoms of woven wire, are employed. These appliances are so well known in the art of brewing that no further description of their construction and use is necessary.

The barley employed for mashing with malt in the converter should be thoroughly cleaned by some of the usual means, as a grain separator, or combined brush polisher, or other efficient cleaning apparatus, by which it is freed from dirt, dust and impurities known as "disease ferments." The requisite quantity of water, which should be about three times the weight of all the grain used, including both

[Price 6d.]

Pigeon & Flanagan's Impts. in the Manufacture of Ale, Beer, and Porter.

the barley and malt, is first pumped into the converter, and the barley and malt are then added, preferably, as follows:—Suppose about 17000 pounds of barley and malt taken together are to be used in the mash, of which about 8500 pounds are barley and about 8500 pounds are malt:—Of this amount of malt, preferably about 2550 pounds, or an amount of malt equal to about thirty per centum of the 5 barley, are to be used in the converter for the preliminary preparation of the mash, the remainder, about 5950 pounds, being withheld for addition at the proper time for the purpose of completing the process as will be hereinafter fully explained.

The water or sweet water, as the case may be, in the converter is brought to a temperature of about 145 degrees Fahrenheit. The barley, cleaned as above 10 described and ground fine, and about 1250 pounds of malt are slowly and uniformly introduced into the converter, the agitators being kept running to thoroughly mix the barley and malt with the water and with each other. The temperature of the mash thus formed is gradually brought up to about 154 degrees Fahrenheit, and then about 650 pounds more of malt are added to the mash. The temperature is 15 still further gradually raised to about 160 degrees and an additional 650 pounds of malt are added. The mash is now very gradually heated to a slightly higher temperature, say to about 162 to 166 degrees, and is kept at near that heat until complete exfoliation takes place. It is preferred that from thirty to sixty minutes should elapse between the introduction of the quantities of malt above named and 20 that the temperature of the mash should be gradually increased during the most of that time.

It is important, if not absolutely essential to produce the required results at temperatures sufficiently low as not to injure the mash, to add the malt in fractional quantities and at different times as above stated, in order that the 25 diastase which is released from each addition of malt by the heated bath may act successively upon the barley to effect complete exfoliation and liquifaction. The efficiency of the introduction of the malt in fractional quantities, to produce complete exfoliation of the grain and render the starchy matter soluable, is ascribed to the somewhat peculiar action of diastase upon grain at low temperatures, in 30 this respect, that a reasonably small quantity added to the mash, at a single time, will do substantially the same amount of work in the particulars named as a much larger quantity added at a single time, and that, consequently, a given quantity of diastase is far more efficient to accomplish the desired results, when caused to act upon the grain in the mash during different intervals of time, than during a single 35 interval.

Whether the above explanation is in all particulars correct or not, it is, however, true that the addition of the malt in fractional quantities and under conditions named, during the preliminary preparation of the mash, will produce the desired 40 exfoliation and liquifaction of the grain, at temperatures that will not injure the mash. By the employment of this method, high temperatures with their injurious results are avoided, the diastase of the malt used can be fully utilized to effect complete exfoliation, while the larger proportion of the malt can be retained or withheld for the subsequent operation of saccharification.

In carrying out this process the spent wort or sweet water containing certain 45 salts and albuminoids assists in producing exfoliation and should be used in all cases where it is practicable.

After complete exfoliation and liquifaction has been produced, as above described, the mash is cooled down to about 145 to 150 degrees, preferably by running cold water into the jacket space, at which temperature the balance of the malt is added, 50 (in the case supposed about 5950 pounds) which will bring the initial heat of saccharification to from 140 to 147 degrees. The temperature is then gradually raised, preferably during from one to two hours, till it reaches about 160 to 164 degrees, when the wort is finished and the entire mass is then dropped into strainers where it should stand for about thirty minutes. 55

In the case above supposed for the purpose of illustration, equal quantities of barley and barley malt are taken. It is not, however, intended thereby to limit

Pigeon & Flanagan's Impts. in the Manufacture of Ale, Beer, and Porter.

our invention to these special proportions. We know that by adding the malt in fractional quantities, aggregating about thirty per centum in weight of the barley used, and treating the mash substantially as set forth, the barley will be completely exfoliated and the mash will be brought into proper condition to receive the subsequent treatment to produce the desired wort. More than thirty per centum of malt could be used in this preliminary process, but it is unnecessary and would be useless. Less than that quantity would undoubtedly give fair results, with the liability, however, of incomplete exfoliation. We do not consider it essential, after the barley has been exfoliated, to add barley malt to the full amount of seventy per centum of the barley used, for the purpose of saccharification or conversion, as considerably less than that proportion will under many, or at least some, conditions give good results; in such case the quantity of malt which would be displaced or dispensed with in our process, as compared with the common process where malt alone is used, would be more than fifty per centum.

It is here remarked that "exfoliation" as used in this specification relates to the bursting and disintegration of the starch cells of the barley, and is produced by the sudden expansion and liquifaction of the contained starch under the action of the diastase which penetrates the cells. We do not understand that the starch is gelatinized, in the sense in which that word is commonly understood, but that it is released from its cells and is taken into solution by the water of the mash.

As the times at which certain steps of the above described process should be taken, as well as the temperatures of the mash at and between such times, are regarded as important to obtain the best results we give below a tabulated statement of working information which we have deduced from careful and successful practice.

In this table the left-hand column marked "Times" refers to the hour and minutes at which the steps and conditions named in the right-hand column marked "Remarks" were taken or existed; the columns marked "Outside" and "Inside" respectively give the temperature in degrees Fahr. of the water in the jacket space by which the mash is heated and cooled and the temperature of the mash itself, during the several times named in the left-hand column, as follows:—

	Times.	Outside.	Inside.	Remarks.
	5.00	145°	145°	Water, Barley and 1st. Malt-Steam Outside.
	5.25	154°	143°	Covers or Converter.
35	6.00	166°	154°	2nd. Malt put in.
	6.50	163°	160°	3rd. Malt put in. Steam turned off.
	7.20	164°	162°	Covers off. Cold water outside.
	7.50	104°	154°	Water turned off outside.
	8.10	116°	150°	4th. Malt put in. Steam turned on.
40	8.40	152°	146°	Covers on. Steam turned off.
	9.20	162°	154°	Steaming slowly outside.
	10.30	166°	160°	Steam turned off and mash dropped.

In giving the above table we wish it understood that we do not limit our invention to the specific times and temperatures therein set forth, nor do we, in referring to the fractional proportions of malt to be added to the grain, limit ourselves to the exact proportions named, since we are aware that fair results can be obtained by the use of somewhat different proportions added at different times and at different temperatures from those given in the said table.

After the mash has been dropped from the converter into the strainers, and when the upper liquid is nearing the solid in the strainers, the mash is sparged with water to exhaust its value. When by this operation the wort becomes too weak for boiling it is pumped back into the converter as "sweet Water" and is available for the next mashing operation. Great care should be taken that the temperature of this weak wort of sweet water does not fall below 150 Fahr. lest it be ruined or injured by the formation of lactic acid or other chemical changes. If it is kept at the temperature named it will remain sound and in good condition

Pigeon & Flanagan's Impts. in the Manufacture of Ale, Beer, and Porter.

for a considerable time. On the other hand it must not be raised to a very high temperature as this would tend to produce an undue coagulation of albuminoids. When the next mashing is about to begin the sweet water is cooled down to about 145 degrees as given in the foregoing table.

By the above described method ordinary barley introduced into the converter in an unmalted state is evidently converted into the equivalent of barley malt, and within five or six hours time a wort is produced which is, in all substantial respects for the purposes of making malt liquors, the equivalent of the ordinary malt wort. The identity of the wort so produced to malt wort is so complete that glucose, grape-sugar and other similar articles which are largely employed to give body to the ordinary malt wort can if desired be added to this wort in the same way and with the same results. By this method as above described the malting of at least fifty per centum of the barley before it is subjected to the mashing operation is unnecessary, and the cost in time, fuel, labor and store-room to convert that proportion of the grain into malt, as well as the loss in valuable wort making properties incurred in such preliminary malting are saved; in other words, the barley introduced into the converter as barley can be made by this method of treatment to take the place of as much or more than fifty per centum of barley malt in the ordinary methods of brewing malt liquors.

After the wort has been produced by the process above described it may be treated in all substantial respects in the subsequent operations of brewing as the ordinary malt wort is treated. Any of the known and common methods and appliances for boiling, hopping or flavoring with hops or other materials, cooling, fermenting, racking and storage may be employed with equal advantage and effect.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1st. The hereindescribed process of preparing barley for use in the manufacture of Ale, beer and porter, which consists in mashing the barley with barley malt, the latter being added in fractional quantities and at different times, and the mash being kept at proper temperatures during the process, substantially as described whereby the barley will be exfoliated at uninjurious temperatures and the mash prepared for conversion into wort by subsequent treatment.

2nd. The hereindescribed process of producing a wort for the manufacture of ale, beer and porter, which consists in mashing barley with barley malt, the latter being added to the mash in fractional quantities and at different times substantially as described whereby the barley is exfoliated at low and harmless temperatures, and then introducing into the mash thus prepared an additional quantity of malt for saccharification, and continuing the mashing, substantially as described, whereby fifty per centum or more of barley malt as used in the common process is dispensed with and ordinary barley substituted therefor, and a wort is produced substantially the equivalent of, if not identical with, the wort produced wholly from barley malt.

Dated this 23rd day of March 1886.

NARCISSE PIGEON.

WILLIAM LIVINGSTONE FLANAGAN.

Haseltine, Lake & Co.,
Agents for the Applicants.

LONDON: Printed by EYRE AND SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.